

भारतीय मानक
पोतनिर्माण — विद्युत वेल्डिड स्टड रहित एंकर जंजीरें तथा
संयोजी सांकलें — विशिष्टि
(दूसरा पुनरीक्षण)

Indian Standard
SHIPBUILDING — ELECTRICALLY WELDED
STUDLESS LINK ANCHOR CHAINS AND
CONNECTING SHACKLES — SPECIFICATION
(*Second Revision*)

ICS 47.020.50

© BIS 2013
BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Shipbuilding Sectional Committee had been approved by the Transport Engineering Division Council.

This standard was first published in 1968 and revised in 1977. In this standard, besides other changes, the chemical composition of raw material has been specified besides proof load and breaking load have been specified, in kN, as per current practices.

This standard is one of a series of Indian Standards on anchor chains, other standards in this series are:

<i>IS No.</i>	<i>Title</i>
4484 : 2010	Shipbuilding — Electrically welded stud link anchor chains and connecting shackles and swivels — Specification (<i>second revision</i>)
4690 : 1968	Specification for mooring buoy shackles
5859 : 1970	Specification for tools for handling of anchor chains and attachments

It is important to note that all dimensions specified in this standard are the dimensions of the various parts of anchor chains after the cables and shackles have been subjected to the statutory proof loads which they have satisfactorily withstood.

Each standard length of chain (27.5 m or part thereof) is connected to the adjoining length by a Dee type joining shackle. When Dee type joining shackle is used, each length shall include one end link at each end. Each length of chain shall be provided with one Dee type joining shackle and shall comprise an odd number of links exclusive of the joining shackle.

In the formulation of this standard, assistance has been derived from the following International Standards:

ISO 1704 : 1973	Shipbuilding anchor chains, issued by the International Organization for Standardization (ISO)
JIS 3303-1969	Electrically welded anchor chain cables, issued by Japanese Standards Association

Rules and Regulation for the Construction and Classification of Steel Ships, Lloyds Register of Shipping, 2008.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

**SHIPBUILDING — ELECTRICALLY WELDED
STUDLESS LINK ANCHOR CHAINS AND
CONNECTING SHACKLES — SPECIFICATION**

(Second Revision)

1 SCOPE

This standard specifies the material, shape, dimensions and tolerances for electrically welded studless link anchor chains with Dee type shackles.

2 REFERENCE

The following standard contains provision which through reference in this text, constitutes provision of this standard. At the time of publication, the edition indicated was valid. All standards are subject to revision and parties to agreements based on this standard is encouraged to investigate the possibility of applying the most recent edition of the standard indicated below:

<i>IS No.</i>	<i>Title</i>
1608 : 1995	Mechanical testing of metals — Tensile testing (<i>third revision</i>)

3 TERMINOLOGY

For the purpose of this standard, the following definitions shall apply.

3.1 Studless Link — The link of an anchor chain with no stud across its minor axis.

3.2 Common Link — The link with which a chain is normally constituted (*see* Fig. 1).

3.3 End Link — The studless link of enlarged dimensions to enable the use of Dee type joining shackle (*see* Fig. 1).

3.4 Dee Type Joining Shackle — It is used for joining two consecutive lengths of anchor chains, this is also known as bolt type shackle (*see* Fig. 1).

3.5 End Shackle — It is similar to Dee type joining shackle but of different dimensions and used to connect the anchor with the chain cable (*see* Fig. 1).

3.6 Nominal Size — The designated diameter of the common link, in millimetre referred to as ' d_n '.

4 MATERIAL

4.1 Steel used for the manufacture of chains shall have the following chemical composition and mechanical properties.

4.1.1 Chemical Composition of Chain Cable and Fittings

<i>Sl No.</i>	<i>Grade</i>	<i>Chemical Composition, Percent</i>					
		<i>C</i> <i>Max</i>	<i>Si</i>	<i>Mn</i>	<i>P</i> <i>Max</i>	<i>S</i> <i>Max</i>	<i>Al</i>
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	Mild steel (Grade 1)	0.20	0.15-0.35	0.40	.040	.040	—
				<i>Min</i>			
ii)	Special steel (Grade 2)	0.24	0.15-0.35	1.60	.040	.040	.02
				<i>Max</i>			<i>Min</i> ¹⁾

¹⁾ Aluminium may be partly replaced by other grain refining elements like Nb and V.

4.1.2 Mechanical Properties of Finished Chain Cable and Fittings

<i>Grade</i>	<i>Tensile Strength, N/mm²</i>
Mild steel (Grade 1)	400-490
Special steel (Grade 2)	490-640

4.2 The steel used for the manufacture of shackles shall in no respect be inferior to that used for the manufacture of chain links.

4.3 Testing of Material**4.3.1 Selection of Test Pieces**

For Grade 1 and Grade 2 chains, the bar material may be tested either in the 'as rolled' condition or after heat treatment.

4.3.2 Selection of test pieces shall be one tensile piece

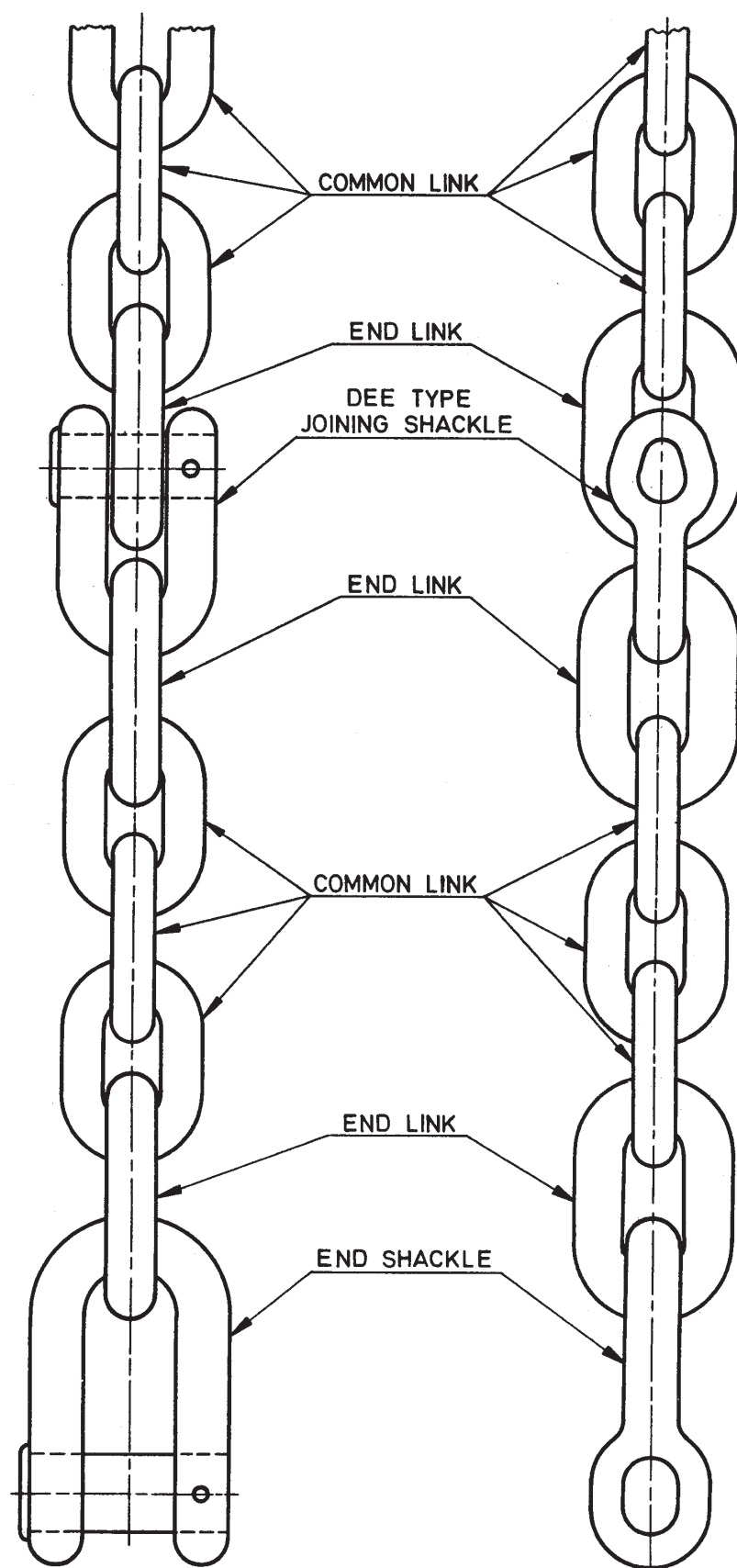


FIG. 1 ASSEMBLY OF SHIPS' STUDLESS LINK ANCHOR CHAINS

from every lot of 50 t or less of the same cast. For machined test pieces, the diameter of the reduced portion and the position of the test piece relative to bar cross-section shall be so selected that the piece is representative of the average properties of bar. The tensile test shall be carried out in accordance with IS 1608. A specimen for tensile test shall be either the full section as rolled or shall be machined to a convenient size provided the area of the reduced portion is not less than 150 mm².

5 PROCESS OF MANUFACTURE

Anchor chains shall be manufactured by a suitable electric butt welding process and after welding they shall be given the appropriate heat treatment. Joining shackles shall be forged or cast and subsequently machined and heat treated.

6 CONSTRUCTION, SHAPE AND DIMENSIONS

6.1 The construction, shape and dimensions shall be as shown in Fig. 1 and Tables 1 to 4.

6.2 The standard length of anchor chains shall be of 27.5 m approximately inclusive of shackle. Each length shall comprise of an odd number of links, exclusive of the joining shackle. Smaller lengths may be supplied to meet customer's requirements.

6.3 All links and shackles shall be of uniform shape. The inside radii of the common and end links shall be sufficient to allow each link to bed properly and work freely. The inside radius of the end links shall be equal to half the inside width and their sides shall be parallel.

7 TOLERANCES

7.1 The allowable manufacturing tolerances on the nominal diameter of each link and shackle shall be as follows:.

<i>Nominal Diameter</i> mm	<i>Manufacturing Tolerance</i> mm
Up to 40	+0 -1
More than 40 and up to 50	+0 -2

The cross-sectional area at the crown of the link and shackle shall be not less than the area of a circle of nominal diameter.

7.2 Length of Five Links

The allowable variation on a length of five links shall be ± 2.5 percent.

7.3 The allowable variation on the overall width and length of each link and shackle shall be ± 2.5 percent.

7.4 Approximate weight per meter length of chain may be calculated approximately by the following formula:

$$\text{Weight/meter} = 0.0217 d_n^2$$

where

d_n = nominal diameter, in mm.

8 HEAT TREATMENT

The chains shall be heat treated as per details given below:

<i>Material</i>	Mild Steel	Special Steel
<i>Grade</i>	1	2
<i>Heat treatment</i>	As welded or Normalized	Normalized or Quenched and tempered

In all cases, heat treatment shall be carried out prior to the proof loading and breaking tests.

9 TESTING OF CHAIN LINKS AND SHACKLES

9.1 Breaking Load Test

The breaking load test of chain links and shackles shall be made in accordance with **9.1.1**, **9.1.2** and **9.1.3**. Breaking load test of chains are to be carried out on each 3 link samples selected from every four lengths. Chain lengths shall have provision for extra links thus selected for breaking load test.

9.1.1 The selected 3 links shall be subjected to the breaking loads as specified in Table 5 according to grade and size of chain. The chains shall be considered to have passed this test, if the test links have shown no sign of failure after application of the required load.

9.1.2 Where a breaking test specimen fails, two additional specimens shall be cut from the same length of cable and subjected to breaking load test. The original cable of chain shall only be accepted in case both these specimens successfully pass the test. If this re-test is successful, the remaining three lengths of chain covered by the sample shall be considered to have passed the breaking load test. If this re-test also fails the length of the cable from which it was taken shall be rejected. The remaining lengths of chains shall be individually tested by taking a breaking load test specimen from each length of the batch.

9.1.3 The accessories shall also be subjected to a breaking load test as specified in Table 5 according to grade and size of chain with which these are used. One

test sample for each 25 Dee type joining shackle or end shackle or a fraction thereof shall be taken for every different size and the sample shall withstand the specified load.

9.1.4 All items subjected to breaking load shall be destroyed and not used in the outfit.

9.2 Proof Load Test

Proof load test of chain links and shackles shall be carried out as given in **9.2.1** and **9.2.2**.

9.2.1 Proof load testing of chains shall be carried out for every length of chain after it has passed the breaking load test as given in **9.1**. Proof load test on chains shall be carried out with the test loads shown in Table 5 according to grade and size of chains. The chains shall be accepted as having passed the proof load test if the chain is free from flaws, cracks and other defects, after the application of the proof load test.

9.2.2 If the chain shows any sign of cracks or other defects, the defective links shall be replaced by new links and the chain is again subjected to proof load test as given in **9.2.1**. However, the retest shall not be permissible if the number of defective links exceed 5 percent of the total number of links in 27.5 m length of the chain.

9.2.3 Proof load test of shackles shall be made by joining similar shackles, samples of which have passed the breaking load test as given in **9.1**. The shackles are accepted having passed the proof load test if they are free from flaws, cracks and other defects after the application of the proof load given in Table 5 according to grade and size of chains. Shackles may also be tested in conjunctions with the chains.

10 DESIGNATION

10.1 The nominal size of the chain cable shall be designated by the nominal diameter (d_n) of the common link.

10.2 The nominal size of other links and shackles shall be designated by the nominal diameter (d_n) of the link.

11 INSPECTION

11.1 The inspection for shapes and dimensions of the chain and shackles shall be made after the completion of the proof test. The dimension of the chain and shackles shall conform to those in Tables 1 to 4 and shall conform to the tolerances given in 7.

12 MARKING

12.1 The first and last link of each chain and all shackles shall be marked with the following:

- a) Manufacturer's name or trade-mark;
- b) Batch number;
- c) Proof load and grade; and
- d) Certification mark of the inspecting authority.

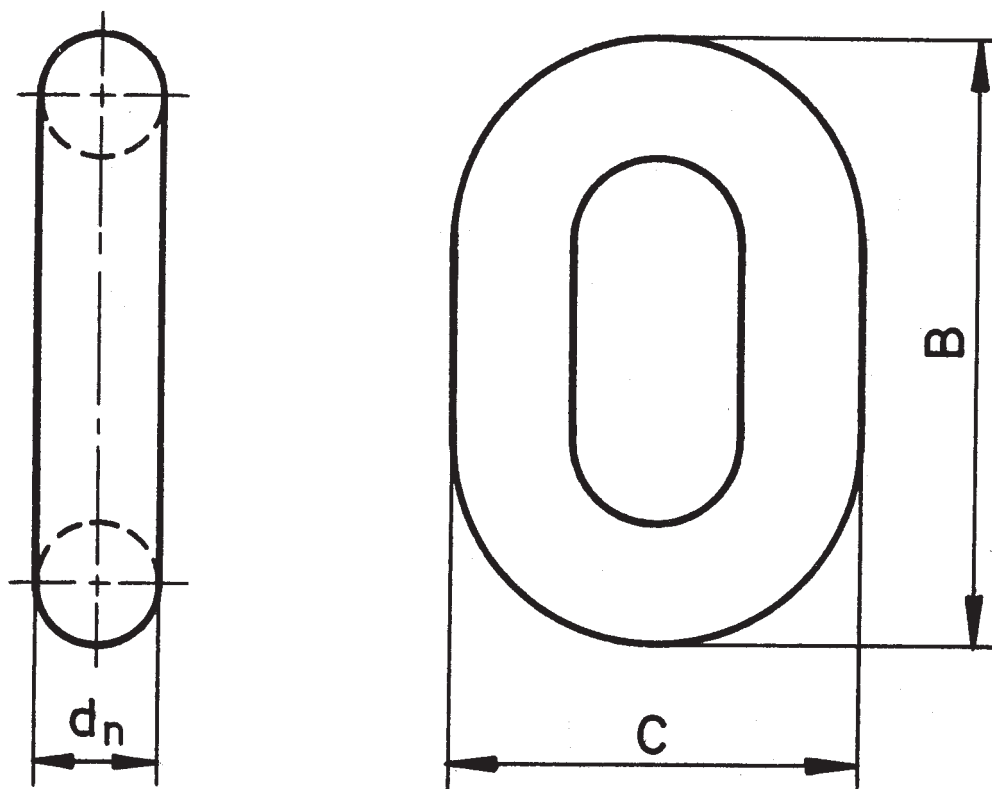
12.2 BIS Certification Marking

The chains and shackles may also be marked with the Standard Mark.

12.2.1 The use of the Standard Mark is governed by the provisions of *Bureau of Indian Standards Act, 1986* and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

Table 1 Dimensions of Common Link
(Clause 6.1)

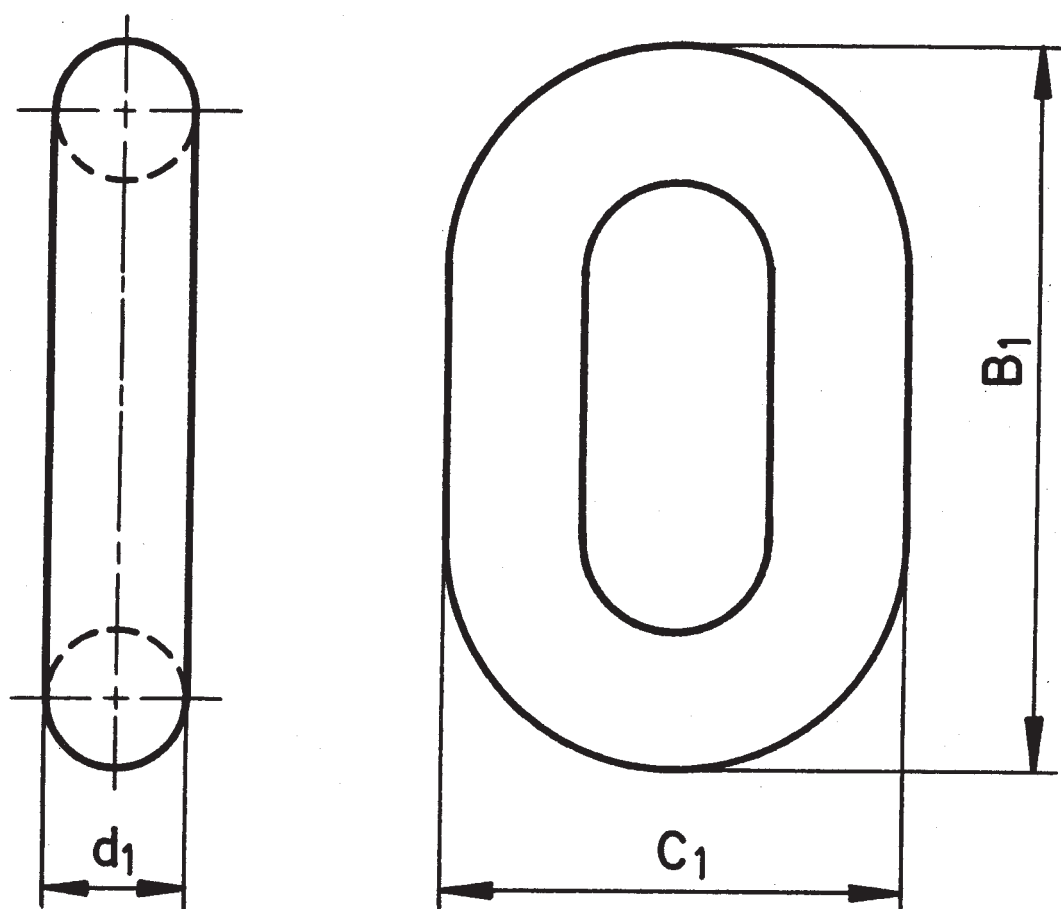
All dimensions in millimetres.



SI No.	Nominal Diameter	B	C	SI No.	Nominal Diameter	B	C
	d_n	(5 d_n)	(3.6 d_n)		d_n	(5 d_n)	(3.6 d_n)
(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
i)	6	30.0	21.6	xv)	24	120.0	86.4
ii)	7	35.0	25.2	xvi)	26	130.0	93.6
iii)	8	40.0	28.8	xvii)	28	140.0	100.8
iv)	9	45.0	32.4	xviii)	30	150.0	108.0
v)	10	50.0	36.0	xix)	32	160.0	115.2
vi)	11	55.0	39.6	xx)	34	170.0	122.4
vii)	12	60.0	43.2	xxi)	36	180.0	129.6
viii)	12.5	62.5	45.0	xxii)	38	190.0	136.8
ix)	14	70.0	50.4	xxiii)	40	200.0	144.0
x)	16	80.0	57.6	xxiv)	42	210.0	151.2
xi)	17.5	87.5	63.0	xxv)	44	220.0	158.4
xii)	19	95.0	68.4	xxvi)	46	230.0	165.6
xiii)	20.5	102.5	73.8	xxvii)	48	240.0	172.8
xiv)	22	110.0	79.2	xxviii)	50	250.0	180.0

Table 2 Dimensions for End Link
(Clause 6.1)

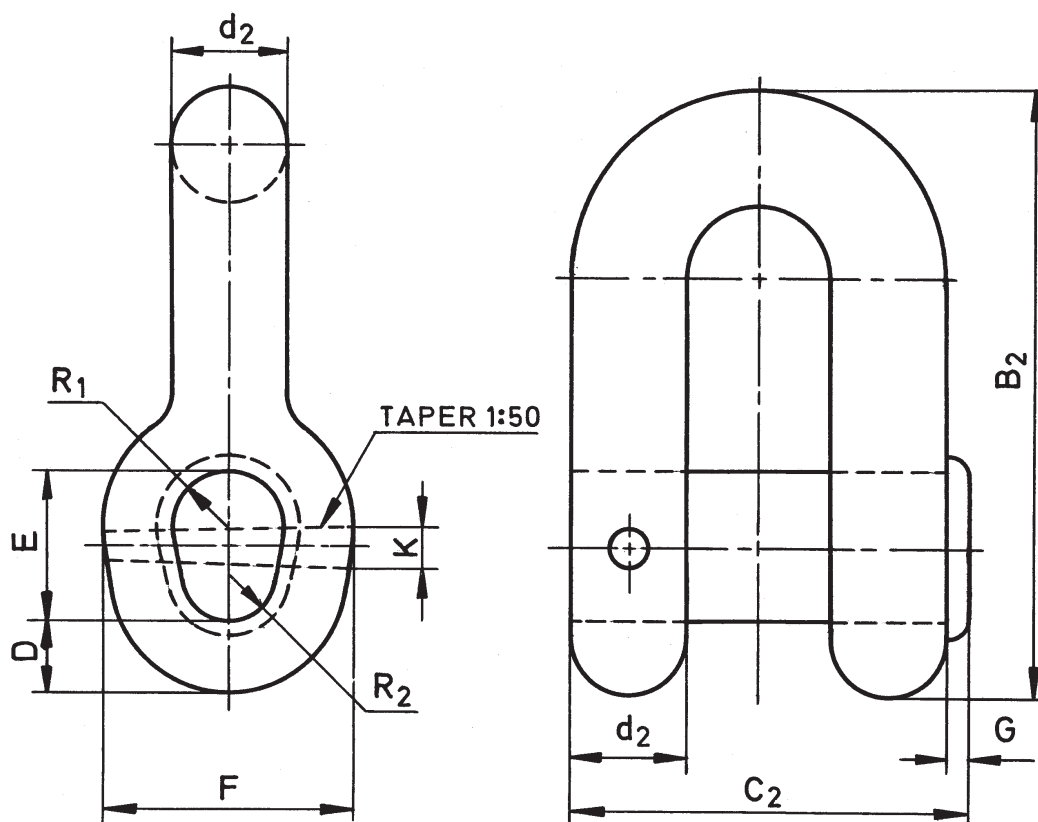
All dimensions in millimetres.



Sl No.	Nominal Diameter	d_1	B_1	C_1	Sl No.	Nominal Diameter	d_1	B_1	C_1
(1)	d_n	(1.1 d_n)	(6 d_n)	(3.8 d_n)	(1)	d_n mm	(1.1 d_n)	(6 d_n)	(3.8 d_n)
	(2)	(3)	(4)	(5)		(2)	(3)	(4)	(5)
i)	6	7	36	23	xv)	24	26	144	91
ii)	7	8	42	27	xvi)	26	29	156	99
iii)	8	9	48	30	xvii)	28	31	168	106
iv)	9	10	54	34	xviii)	30	33	180	114
v)	10	11	60	38	xix)	32	35	192	122
vi)	11	12	66	42	xx)	34	37	204	129
vii)	12	13	72	46	xxi)	36	40	216	137
viii)	12.5	14	75	48	xxii)	38	42	228	144
ix)	14	15	84	53	xxiii)	40	44	240	152
x)	16	18	96	61	xxiv)	42	46	252	160
xi)	17.5	19	105	67	xxv)	44	48	264	167
xii)	19	21	114	72	xxvi)	46	51	276	175
xiii)	20.5	23	123	78	xxvii)	48	53	288	182
xiv)	22	24	132	84	xxviii)	50	55	300	190

Table 3 Dimensions for Dee Type Joining Shackle with Shackle Pin
(Clause 6.1)

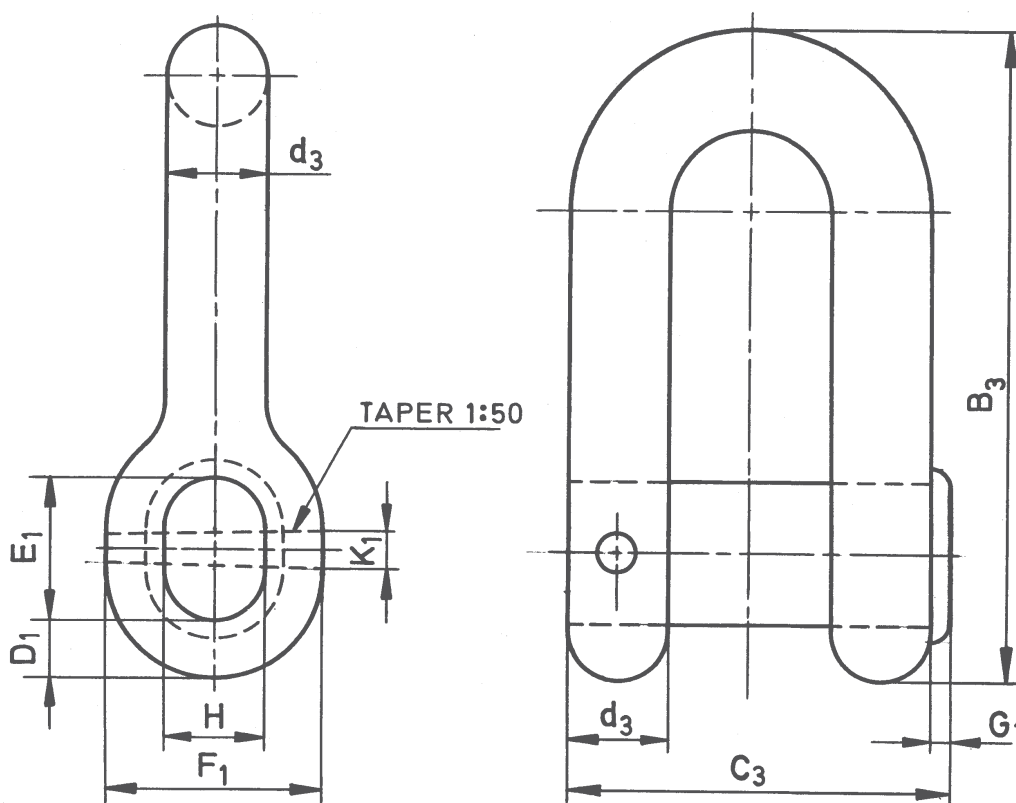
All dimensions in millimetres.



Sl No.	Nominal Diameter	d_2	B_2	C_2	D	E	F	G	K	$2R_1$	$2R_2$
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
i)	6	7	37	23	4	9	15	1		7	6
ii)	7	8	43	27	5	11	18	1		8	7
iii)	8	10	49	30	6	12	20	2	4	9	8
iv)	9	11	55	34	6	14	23	2		10	8
v)	10	12	61	38	7	15	26	2		11	9
vi)	11	13	67	42	8	17	28	2		12	10
vii)	12	14	73	46	9	18	31	2		14	11
viii)	12.5	15	76	48	9	19	32	2		14	12
ix)	14	17	85	53	10	21	36	3		16	13
x)	16	19	98	61	11	24	41	3		18	15
xi)	17.5	21	107	67	12	26	45	3		20	16
xii)	19	23	116	72	13	29	48	4	8	21	18
xiii)	20.5	25	125	78	15	31	52	4		23	19
xiv)	22	26	134	84	16	33	56	4		25	21
xv)	24	29	146	91	17	36	61	5		27	23
xvi)	26	31	159	99	18	39	66	5		29	24
xvii)	28	34	171	106	20	42	71	5		32	26
xviii)	30	36	183	114	21	45	77	6		34	28
xix)	32	38	195	122	23	48	82	6		36	30
xx)	34	41	207	129	24	51	87	6		38	32
xxi)	36	43	220	137	26	54	92	7		41	34
xxii)	38	46	232	144	27	57	97	7		43	36
xxiii)	40	48	244	152	28	60	102	8	18	45	38
xxiv)	42	50	256	160	30	63	107	8		47	39
xxv)	44	53	268	167	31	66	112	8		50	41
xxvi)	46	55	281	175	33	69	117	9		52	43
xxvii)	48	58	293	182	34	72	122	9		54	45
xxviii)	50	60	305	190	36	75	128	10		57	47

Table 4 Dimensions for End Shackle with Shackle Pin
(Clause 6.1)

All dimensions in millimetres.



SI No.	Nominal Diameter	d_3	B_3	C_3	D_1	E_1	F_1	G_1	K_1	H
(1)	d_n	$(1.32 d_n)$	$(8.5 d_n)$	$(4.75 d_n)$	$(0.75 d_n)$	$(1.9 d_n)$	$(2.82 d_n)$	$(0.19 d_n)$	$(0.4 d_n)$	$(1.32 d_n)$
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
i)	6	8	51	29	5	11	17	1		8
ii)	7	9	60	33	5	13	20	1		9
iii)	8	11	68	38	6	15	23	2	4	11
iv)	9	12	77	43	7	17	25	2		12
v)	10	13	85	48	8	19	28	2		13
vi)	11	15	94	52	8	21	31	2		15
vii)	12	16	102	57	9	23	34	2		16
viii)	12.5	17	106	59	9	24	35	2		17
ix)	14	18	119	67	11	27	39	3		18
x)	16	21	136	76	12	30	45	3		21
xi)	17.5	23	149	83	13	33	49	3		23
xii)	19	25	162	90	14	36	54	4	8	25
xiii)	20.5	27	174	97	15	39	58	4		27
xiv)	22	29	187	105	17	42	62	4		29
xv)	24	32	204	114	18	46	68	5		32
xvi)	26	34	221	124	20	49	73	5		34
xvii)	28	37	238	133	21	53	79	5		37
xviii)	30	40	255	143	23	57	85	6		40
xix)	32	42	272	152	24	61	90	6		42
xx)	34	45	289	162	26	65	96	6		45
xxi)	36	48	306	171	27	68	102	7		48
xxii)	38	50	323	181	29	72	107	7		50
xxiii)	40	53	340	190	30	76	113	8	18	53
xxiv)	42	55	357	200	32	80	118	8		55
xxv)	44	58	374	209	33	84	124	8		58
xxvi)	46	61	391	219	35	87	130	9		61
xxvii)	48	63	408	228	36	91	135	9		63
xxviii)	50	66	425	238	38	95	141	10		66

Table 5 Proof Load and Breaking Load for Studless Link Anchor Chain Cables
(Clauses 9.1.1, 9.1.3, 9.2.1 and 9.2.3)

SI No.	Nominal Diameter <i>d</i> mm	Mild Steel Grade 1		Special Steel Grade 2	
		Proof Load kN	Breaking Load kN	Proof Load kN	Breaking Load kN
(1)	(2)	(3)	(4)	(5)	(6)
i)	6	8.9	17.8	11.4	22.8
ii)	7	12.5	25.0	15.9	31.8
iii)	8	15.9	31.8	20.2	40.4
iv)	9	20.0	40.0	25.5	51.0
v)	10	24.8	49.6	31.5	63.0
vi)	11	30.0	60.0	38.1	76.2
vii)	12	35.7	71.4	45.3	90.6
viii)	12.5	38.7	77.4	49.1	98.2
ix)	14	48.6	97.2	63.0	126.0
x)	16	63.5	127.0	81.0	162.0
xi)	17.5	76.0	152.0	96.3	192.6
xii)	19	89.3	178.6	113.5	227.0
xiii)	20.5	104.0	208.0	132.0	264.0
xiv)	22	120.0	240.0	155.0	310.0
xv)	24	142.6	285.2	181.0	362.0
xvi)	26	167.0	334.0	213.0	426.0
xvii)	28	194.5	389.0	247.0	494.0
xviii)	30	223.0	446.0	283.0	566.0
xix)	32	254.0	508.0	322.0	644.0
xx)	34	286.0	572.0	364.0	728.0
xxi)	36	321.5	643.0	408.0	816.0
xxii)	38	358.0	716.0	454.0	908.0
xxiii)	40	397.0	794.0	503.0	1 006.0
xxiv)	42	437.0	874.0	555.0	1 110.0
xxv)	44	480.0	960.0	610.0	1 220.0
xxvi)	46	524.0	1 048.0	665.0	1 330.0
xxvii)	48	570.0	1 140.0	725.0	1 450.0
xxviii)	50	619.0	1 238.0	786.0	1 572.0

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act*, 1986 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Copyright

BIS has the copyright of all its publications. No part of these publications may be reproduced in any form without the prior permission in writing of BIS. This does not preclude the free use, in the course of implementing the standard, of necessary details, such as symbols and sizes, type or grade designations. Enquiries relating to copyright be addressed to the Director (Publications), BIS.

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards : Monthly Additions'.

This Indian Standard has been developed from Doc No.: TED 17 (715).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002

Telephones : 2323 0131, 2323 3375, 2323 9402

Website: www.bis.org.in

Regional Offices:

Telephones

Central	: Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110002	{ 2323 7617 2323 3841
Eastern	: 1/14 C.I.T. Scheme VII M, V. I. P. Road, Kankurgachi KOLKATA 700054	{ 2337 8499, 2337 8561 2337 8626, 2337 9120
Northern	: SCO 335-336, Sector 34-A, CHANDIGARH 160022	{ 60 3843 60 9285
Southern	: C.I.T. Campus, IV Cross Road, CHENNAI 600113	{ 2254 1216, 2254 1442 2254 2519, 2254 2315
Western	: Manakalaya, E9 MIDC, Marol, Andheri (East) MUMBAI 400093	{ 2832 9295, 2832 7858 2832 7891, 2832 7892

Branches: AHMEDABAD. BANGALORE. BHOPAL. BHUBANESHWAR. COIMBATORE. DEHRADUN. FARIDABAD. GHAZIABAD. GUWAHATI. HYDERABAD. JAIPUR. KANPUR. LUCKNOW. NAGPUR. PARWANOO. PATNA. PUNE. RAJKOT. THIRUVANANTHAPURAM. VISAKHAPATNAM.

Published by BIS, New Delhi